Evaluation of Juvenile White Sturgeon Salvage Efficiency at the Tracy Fish Collection Facility

Investigators

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Summary

The Tracy Fish Collection Facility (TFCF) was designed to divert juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and striped bass (*Morone saxatilis*) from south Sacramento-San Joaquin (Delta) flows (Bates *et al*. 1960). The TFCF uses a louver-bypass system to divert and guide fish into collection tanks, where they are held until they are transported back to the Delta, away from the facility. Fish and exported flows enter the facility through a trashrack with 5.1-cm-wide (2.0-in) bar spacing and travel through the 25.6-m-wide (84-ft) primary channel to one of four bypass entrances along the louver wall. Once inside the bypass entrance, fish travel downward into underground bypass tubes to the secondary channel where they encounter a double louver wall. Fish that are guided successfully by these louvers are diverted to one of four holding tanks. One to three times daily, fish are removed from each holding tank and returned to the Delta.

The efficiency of louvering systems to properly guide fish is dependent on the water velocity in the facility's primary and secondary channels and the bypass ratio (BR), defined as the ratio of the water velocity entering the bypass openings to the average channel velocity upstream of the louvers (Bates *et al.* 1960, DWR 1967a, 1967b, Bowen *et al*. 2004). Bypass ratios above 1.0 provide a "capture velocity" when fish near the bypass entrance.

Water velocity and BR are such critical components guiding the efficiency of the TFCF that special operating guidelines have been specified in multiple regulatory

documents (SWRCB Decision-1485, NMFS 2004, USFWS 2004). Primary channel velocity is controlled by the number of pumps operating at the Jones Pumping Plant (JPP) and the tidal stage, and there are no legal requirements for maintaining a certain velocity. The minimal current facility criteria are as follows:

- Primary BR always >1.0 (average primary bypass entrance velocity/ average primary channel velocity)
- Secondary BR always >1.0 (average secondary bypass entrance velocity/ average secondary channel velocity)
- Secondary Channel Velocity approximately 0.3–0.45 m/s (1.0–1.5 ft/s) May 15–October 31
- Secondary Channel Velocity approximately 0.9 m/s (3.0 ft/s) November1–May 14

In FY 2009, we completed 12-day only release recovery efficiency experiments with juvenile white sturgeon (*Acipenser transmontanus*) at low primary channel velocities (< 0.5 m/s, 1.8 ft/s; 2–3 JPP pumps in operation and with a secondary channel velocity averaging 0.9 m/s (3.0 fps)). We plan to conduct similar tests during higher pumping periods (4–5 JPP pumps) and include night experiments.

Problem Statement

Green sturgeon (*Acipenser medirostris*) is declining in the Central Valley of California and is listed as a Species of Concern by California Department of Fish and Game. This project will measure Whole Facility Efficiency (WFE), Primary Louver Efficiency (PLE), and Secondary Louver Efficiency (SLE) of juvenile white sturgeon as a surrogate for green sturgeon. Juvenile white and green sturgeon are uncommon at the TFCF, but may be entrained in the fish salvage throughout the year

Goals and Hypotheses

Goal:

1. Determine facility efficiency (WFE, PLE, SLE) when secondary channel velocity is approximately 0.9 m/s (3 fps) and primary BR >1.

Hypothesis:

1. There is no difference in white sturgeon WFE, PLE, and SLE at varying primary bypass ratios.

Materials and Methods

We will use release recapture experiments to measure facility efficiencies. We will determine which type of test will be performed depending on the number of pumps in operation.

Juvenile white sturgeon (3,000) will be obtained from Sturgeon Caviar, Galt, California, in summer when fish are post larvae. Fish will be held in flow-through 750-L (198-gal) tanks in well water (18 ^{o}C) and fed Silver Cup salmon feed. We plan to experiment with these fish when they are about 100–127 mm (4–5 in). Two weeks prior to testing, 2,900 fish will be fin tagged with fluorescent microbeads (New West

Technology, Arcata, California) into the following tag groups: Tags 1–4: 425 fish each (16 primary channel releases, 8 day/8 night), Tags 5–8: 180 fish each (16 secondary channel releases, 8 day/8 night). One hundred fish will be fin-clipped for holding tank control releases. These fish are released to test whether the lift bucket and screen are securely in place each experiment, and can be reused in subsequent experiments. Experimental fish will be acclimated to ambient Delta water conditions for 7 days prior to use.

For each experiment (3 per 24-h period), 100 fish will be released at five locations (20 per location) just downstream of the trashrack, 40 fish released at the anterior end of the secondary channel, and 10 fish released into the holding tank. Each morning before the experiments begin, the trashrack and primary louver array will be cleaned. Then the secondary louver arrays will be cleaned and predators removed from the secondary channel. We will begin preparation for an experiment by counting test fish and placing them in 18.9-L (5-gal) buckets (20 fish/bucket). While counting takes place, the target secondary channel velocity and primary bypass ratio is achieved by manipulation of the VC pumps. Once target hydraulics are established and stabilized, Experiment 1 for that 24-h period will begin. This will be repeated 30 and 60 min later for a total of three experimental releases per 24-h period. Holding tank and sieve net samples will be taken simultaneously every ½ h for at least 2 h (experimental duration will be determined in a preliminary experiment described at the end of this section). Recovered fish will be sorted by color code and measured.

Hydraulic measurements will be taken every 30 min throughout each experiment to ensure that average secondary channel velocity remains within the acceptable target condition range (± 0.06 m/s). Hydraulic data include channel velocities and depths in the primary and secondary channels, discharge in the secondary channel and holding tank, primary and secondary channel bypass ratios, and ambient light condition.

Data Analyses

WFE will be calculated using:

WFE= (# recovered in the holding tank/100) X Holding Tank Efficiency (HTE)

SLE will be calculated using:

SLE= (# recovered in the holding tank/# recovered in the holding tank+# recovered in the sieve net) X HTE, and

PLE will be estimated using:

PLE = (WFE/SLE) X HTE

Analysis of Variance or Kruskall-Wallis (if assumptions for parametric statistics are not met) will be used to compare efficiency estimates among facility conditions

Preliminary Experiment

We will conduct a preliminary experiment to determine the appropriate length of time to collect fish following release. We will release three groups of fish as described above. Then, we will recover fish in both alternating holding tanks and sieve nets every 30 min for 4 h, then overnight for a total of 24 h. The number of fish recovered per time period will be divided by the total number recovered at the end of the 24-h monitoring period to obtain the proportion of experimental fish recovered in that collection period. From this, we will determine how long to collect fish following release.

Coordination and Collaboration

These studies will be coordinated with the California Department of Fish and Game's Delta diversion facilities reporting program, and the Tracy Fish Collection Facility staff. All work will be reviewed by the Tracy Technical Advisory Team through progress updates on request and reviews of study plans and all reports.

Endangered Species Concerns

Incidental "take" of ESA listed salmon, steelhead, and delta smelt is possible and such fish will be returned to Delta waters as quickly as possible. The total number of each ESA species incidentally caught or collected during the experiment will be recorded and sent to the reporting agencies. The incidental take from this research is covered under the TFCF Section 10 permit.

Dissemination of Results (Deliverables and Outcomes)

We will complete these experiments in FY 2010 or FY 2011. We will publish a draft summary draft report in 2011 (including FY 2009 data) as a volume in the Tracy Technical Report Series, and report findings to the Tracy Technical Advisory Team.

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